

AMENDMENTS TO THE CLAIMS

The listing of the claims will replace all prior versions, and listings, of claims:

LISTING OF CLAIMS:

Claims 1-38 (canceled)

Claim 39 (original): A method of multivariate spectral analysis, comprising the steps of:

- a) obtaining an estimate of spectral error covariance E_A for measured set of multivariate spectral data A ;
- b) decomposing the spectral error covariance E_A according to $E_A = TP + E$, where T is a set of $n \times r$ scores and P is a set of $r \times p$ loading vectors obtained from factor analysis of the spectral error covariance E_A , and E is a set of $n \times p$ random errors and spectral variations not useful for prediction;
- c) guessing pure-component spectra K for the set of multivariate spectral data A ;
- d) predicting a set of component values \hat{C} according to

$$\hat{C} = AK^T(KK^T)^{-1} = A(K^T)^+;$$

- e) augmenting the set of predicted component values \hat{C} with at least one vector of the T scores to obtain a first set of augmented component values $\tilde{\hat{C}}$;

f) estimating augmented pure-component spectra \tilde{K} according to

$$\tilde{K} = (\tilde{\hat{C}}^T\tilde{\hat{C}})^{-1}\tilde{\hat{C}}^T A = \tilde{\hat{C}}^+ A;$$

g) testing for convergence according to $\left\| A - \tilde{\hat{C}}\tilde{K} \right\|^2$;

h) predicting a second set of augmented component values $\hat{\tilde{C}}$ according to

$$\hat{\tilde{C}} = A\tilde{K}^T(\tilde{K}\tilde{K}^T)^{-1} = A(\tilde{K}^T)^+;$$

- i) replacing the augmented portion of the second set of augmented component values $\hat{\tilde{C}}$ with the at least one vector of the T scores to obtain a third set of augmented component values $\tilde{\hat{C}}$; and
- j) repeating steps f) through i) at least once.

Claim 40 (original): The method of Claim 39, wherein the steps f) through i) are repeated until the test of step g) converges to obtain an alternating classical least squares solution for $\hat{\mathbf{K}}$ and $\hat{\mathbf{C}}$.

Claim 41 (original): The method of Claim 39, further comprising replacing the augmented portion of the augmented pure-component spectra $\hat{\mathbf{K}}$ with at least one vector of the \mathbf{P} loading vectors prior to step h).

Claim 42 (original): The method of Claim 39, further comprising augmenting $\hat{\mathbf{K}}$ with at least one vector representing a spectral shape that is representative of at least one additional source of spectral variation prior to step h).

Claim 43 (original): The method of Claim 39, further comprising applying at least one constraint to the non-augmented portion of $\hat{\mathbf{K}}$ at step f).

Claim 44 (original): The method of Claim 43, wherein the at least one constraint is selected from the group consisting of non-negativity, equality, closure, monotonic constraint, unimodality, and selectivity.

Claim 45 (original): The method of Claim 39, further comprising applying at least one constraint to the non-augmented portion of $\hat{\mathbf{C}}$ at step h).

Claim 46 (original): The method of Claim 45, wherein the at least one constraint is selected from the group consisting of non-negativity, equality, closure, monotonic constraint, unimodality, and selectivity.

Claim 47 (original): The method of Claim 39, wherein the guessed pure-component spectra \mathbf{K} comprises random numbers.

Claim 48 (original): The method of Claim 39, wherein the measured set of multivariate spectral data \mathbf{A} comprises image data.

Claim 49 (original): The method of Claim 48, wherein the spectral error covariance \mathbf{E}_A is obtained from a shift difference generated from a single image.

Claim 50 (original): The method of Claim 48, wherein the spectral error covariance E_A is obtained from repeat image spectra.

Claim 51 (original): A method of multivariate spectral analysis, comprising the steps of:

- a) obtaining an estimate of spectral error covariance E_A for measured set of multivariate spectral data A ;
- b) decomposing the spectral error covariance E_A according to $E_A = TP + E$, where T is a set of $n \times r$ scores and P is a set of $r \times p$ loading vectors obtained from factor analysis of the spectral error covariance E_A , and E is a set of $n \times p$ random errors and spectral variations not useful for prediction;
- c) guessing pure-component spectra K for the set of multivariate spectral data A ;
- d) augmenting the pure-component spectra K with at least one vector of the P loading vectors to obtain first augmented pure-component spectra \tilde{K} ;
- e) predicting a first set of augmented component values \hat{C} according to
$$\hat{C} = A\tilde{K}^T(\tilde{K}\tilde{K}^T)^{-1} = A(\tilde{K}^T)^+$$
;
- f) estimating second augmented pure-component spectra $\hat{\tilde{K}}$ according to
$$\hat{\tilde{K}} = (\hat{C}^T\hat{C})^{-1}\hat{C}^TA = \hat{C}^+A$$
;
- g) testing for convergence according to
$$\left\| A - \hat{C}\hat{K} \right\|^2$$
;
- h) replacing the augmented portion of the second augmented pure-component spectra $\hat{\tilde{K}}$ with the at least one vector of the P loading vectors to obtain third augmented pure-component spectra \hat{K} ; and
- i) predicting a second set of augmented component values \hat{C} according to
$$\hat{C} = A\hat{K}^T(\hat{K}\hat{K}^T)^{-1} = A(\hat{K}^T)^+$$
;
- j) repeating steps f) through i) at least once.

Claim 52 (original): The method of Claim 51, wherein the steps f) through i) are repeated until the test of step g) converges to obtain an alternating classical least squares solution for $\hat{\mathbf{K}}$ and $\hat{\mathbf{C}}$.

Claim 53 (original): The method of Claim 51, further comprising replacing the augmented portion of the set of augmented component values $\hat{\mathbf{C}}$ with at least one vector of the \mathbf{T} scores prior to step h).

Claim 54 (original): The method of Claim 51, further comprising augmenting $\hat{\mathbf{K}}$ with at least one vector representing a spectral shape that is representative of at least one additional source of spectral variation prior to step h).

Claim 55 (original): The method of Claim 51, further comprising applying at least one constraint to the non-augmented portion of $\hat{\mathbf{K}}$ at step f).

Claim 56 (original): The method of Claim 55, wherein the at least one constraint is selected from the group consisting of non-negativity, equality, closure, monotonic constraint, unimodality, and selectivity.

Claim 57 (original): The method of Claim 51, further comprising applying at least one constraint to the non-augmented portion of $\hat{\mathbf{C}}$ at step h).

Claim 58 (original): The method of Claim 57, wherein the at least one constraint is selected from the group consisting of non-negativity, equality, closure, monotonic constraint, unimodality, and selectivity.

Claim 59 (original): The method of Claim 51, wherein the guessed pure-component spectra \mathbf{K} comprises random numbers.

Claim 60 (original): The method of Claim 51, wherein the measured set of multivariate spectral data \mathbf{A} comprises image data.

Claim 61 (original): The method of Claim 60, wherein the estimate of the error covariance $\mathbf{E}_\mathbf{A}$ is obtained from a shift difference generated from a single image.

Claim 62 (original): The method of Claim 60, wherein the estimate of the error covariance E_A is obtained from repeat image spectra.

Claim 63 (original): A method of multivariate spectral analysis, comprising the steps of:

- a) obtaining an estimate of the spectral error covariance E_A for measured set of multivariate spectral data A ;
- b) decomposing the spectral error covariance E_A according to $E_A = TP + E$, where T is a set of $n \times r$ scores and P is a set of $r \times p$ loading vectors obtained from factor analysis of the spectral error covariance E_A , and E is a set of $n \times p$ random errors and spectral variations not useful for prediction;
- c) guessing a set of component values C for the set of multivariate spectral data A ;
- d) estimating pure-component spectra \hat{K} according to $\hat{K} = (C^T C)^{-1} C^T A = C^+ A$;
- e) augmenting the pure-component spectra \hat{K} with at least one vector of the P loading vectors to obtain first augmented pure-component spectra $\hat{\tilde{K}}$;
- f) predicting a first set of augmented component values $\hat{\tilde{C}}$ according to $\hat{\tilde{C}} = A \hat{\tilde{K}}^T (\hat{K} \hat{\tilde{K}}^T)^{-1} = A (\hat{\tilde{K}}^T)^+$;
- g) testing for convergence according to $\|A - \hat{\tilde{C}} \hat{\tilde{K}}\|^2$;
- h) estimating second augmented pure-component spectra $\hat{\tilde{K}}$ according to $\hat{\tilde{K}} = (\hat{\tilde{C}}^T \hat{\tilde{C}})^{-1} \hat{\tilde{C}}^T A = \hat{\tilde{C}}^+ A$;
- i) replacing the augmented portion of the second augmented pure-component spectra $\hat{\tilde{K}}$ with the at least one vector of the P loading vectors to obtain a third augmented pure-component spectra $\hat{\tilde{K}}$ and
- j) repeating steps f) through i) at least once.

Claim 64 (original): The method of Claim 63, wherein the steps f) through i) are repeated until the test of step g) converges to obtain an alternating classical least squares solution for \hat{K} and $\hat{\tilde{C}}$.

Claim 65 (original): The method of Claim 63, further comprising replacing the augmented portion of the set of augmented component values $\hat{\mathbf{C}}$ with at least one vector of the T scores prior to step h).

Claim 66 (original): The method of Claim 63, further comprising augmenting $\hat{\mathbf{K}}$ with at least one vector representing a spectral shape that is representative of at least one additional source of spectral variation prior to step h).

Claim 67 (original): The method of Claim 63, further comprising applying at least one constraint to the non-augmented portion of $\hat{\mathbf{K}}$ at step h).

Claim 68 (original): The method of Claim 67, wherein the at least one constraint is selected from the group consisting of non-negativity, equality, closure, monotonic constraint, unimodality, and selectivity.

Claim 69 (original): The method of Claim 63, further comprising applying at least one constraint to the non-augmented portion of $\hat{\mathbf{C}}$ at step f).

Claim 70 (original): The method of Claim 69, wherein the at least one constraint is selected from the group consisting of non-negativity, equality, closure, monotonic constraint, unimodality, and selectivity.

Claim 71 (original): The method of Claim 63, wherein the guessed set of component values \mathbf{C} comprises random numbers.

Claim 72 (original): The method of Claim 52, wherein the measured set of multivariate spectral data \mathbf{A} comprises image data.

Claim 73 (original): The method of Claim 62, wherein the spectral error covariance \mathbf{E}_A is obtained from a shift difference generated from a single image.

Claim 74 (original): The method of Claim 62, wherein the spectral error covariance \mathbf{E}_A is obtained from repeat image spectra.

Claim 75 (original): A method of multivariate spectral analysis, comprising the steps of:

a) obtaining an estimate of the spectral error covariance E_A for measured set of multivariate spectral data A ;

b) decomposing the spectral error covariance E_A according to $E_A = TP + E$, where T is a set of $n \times r$ scores and P is a set of $r \times p$ loading vectors obtained from factor analysis of the spectral error covariance E_A , and E is a set of $n \times p$ random errors and spectral variations not useful for prediction;

c) guessing a set of component values C for the set of multivariate spectral data A ;

d) augmenting the set of component values C with at least one vector of the T scores to obtain a first set of augmented component values \tilde{C} ;

e) estimating augmented pure-component spectra \hat{K} according to

$$\hat{K} = (\tilde{C}^T \tilde{C})^{-1} \tilde{C}^T A = \tilde{C}^+ A;$$

f) testing for convergence according to $\|A - \tilde{C} \hat{K}\|^2$;

g) predicting a second set of augmented component values $\hat{\tilde{C}}$ according to

$$\hat{\tilde{C}} = A \hat{K}^T (\hat{K} \hat{K}^T)^{-1} = A (\hat{K}^T)^+$$
;

h) replacing the augmented portion of the second set of augmented component values $\hat{\tilde{C}}$ with the at least one vector of the T scores to obtain a third set of augmented component values $\hat{\tilde{C}}$ and

i) repeating steps e) through h) at least once, using the augmented component values $\hat{\tilde{C}}$ in step f).

Claim 76 (original): The method of Claim 75, wherein the steps e) through h) are repeated until the test of step g) converges to obtain an alternating classical least squares solution for \hat{K} and $\hat{\tilde{C}}$.

Claim 77 (original): The method of Claim 75, further comprising replacing the augmented portion of the augmented pure-component spectra \hat{K} with at least one vector of the P loading vectors prior to step e).

Claim 78 (original): The method of Claim 75, further comprising augmenting $\hat{\mathbf{K}}$ with at least one vector representing a spectral shape that is representative of at least one additional source of spectral variation prior to step e).

Claim 79 (original): The method of Claim 75, further comprising applying at least one constraint to the non-augmented portion of $\hat{\mathbf{K}}$ at step e).

Claim 80 (original): The method of Claim 79, wherein the at least one constraint is selected from the group consisting of non-negativity, equality, closure, monotonic constraint, unimodality, and selectivity.

Claim 81 (original): The method of Claim 75, further comprising applying at least one constraint to the non-augmented portion of $\hat{\mathbf{C}}$ at step g).

Claim 82 (original): The method of Claim 81, wherein the at least one constraint is selected from the group consisting of non-negativity, equality, closure, monotonic constraint, unimodality, and selectivity.

Claim 83 (original): The method of Claim 75, wherein the guessed set of component values \mathbf{C} comprises random numbers.

Claim 84 (original): The method of Claim 75, wherein the measured set of multivariate spectral data \mathbf{A} comprises image data.

Claim 85 (original): The method of Claim 84, wherein the spectral error covariance \mathbf{E}_A is obtained from a shift difference generated from a single image.

Claim 86 (original): The method of Claim 84, wherein the spectral error covariance \mathbf{E}_A is obtained from repeat image spectra.

CONCLUSION

Applicants have canceled the nonelected claims and urge that the application is now in condition for allowance.

Respectfully submitted,



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I hereby certify that this correspondence and documents referred to herein were deposited with the United States Postal Service as first class mail addressed to: Commissioner for Patents, Alexandria, VA 22313-1450 on the date shown below.

Date: 7/13/04

By: Martha Tujillo